

CLAIMS

1. A catalyst supporting substrate comprising:
a first region which is formed on a substrate; and
a second region which is formed covering a part of
5 said first region;
wherein said first region includes a catalyst
supporting portion containing a first material,
said second region includes a catalyst portion
containing a second material which is different from said
10 first material,
said first material includes a metal containing at
least one of elements selected from the second group to
the fourteenth group of the periodic table or a compound
thereof, and
15 said second material is a catalyst which grows carbon
nanotubes in a vapor phase.
2. The catalyst supporting substrate according to claim
1, wherein said carbon nanotubes include single-wall
20 carbon nanotubes.
3. The catalyst supporting substrate according to claim
1, wherein said second material includes a metal containing
at least one of elements selected from a group consisting
25 of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, La, Y, Mo and Mn
or a compound thereof.

4. The catalyst supporting substrate according to claim
3, wherein said first material includes a metal containing
at least one of elements selected from a group consisting
of Al, Mo, Ti, Ta, Cr, Cu, Mn, Mg, Zr, Hf, W, Ru, Rh, Zn
5 and Sn or a compound thereof.

5. The catalyst supporting substrate according to claim
1, wherein said first region includes a metal film which
contains said first material and is formed on said
10 substrate, and

said catalyst supporting portion includes a film that
an upper portion of said metal film is oxidized or
hydroxylated.

15 6. The catalyst supporting substrate according to claim
5, wherein said second material includes a metal containing
at least one of elements selected from a group consisting
of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, La, Y, Mo and Mn
or a compound thereof.

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7. The catalyst supporting substrate according to claim
6, wherein said first material includes a metal containing
at least one of elements selected from a group consisting
of Al, Mo, Ti, Ta, Cr, Cu, Mn, Mg, Zr, Hf, W, Ru, Rh, Zn
25 and Sn or a compound thereof.

8. The catalyst supporting substrate according to claim

7, wherein a surface of said catalyst supporting portion includes at least one selected from aluminum natural oxide film, boehmite, α alumina, γ alumina, δ alumina, and θ alumina.

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9. A transistor comprising:

a catalyst containing film which is placed on a substrate and grows carbon nanotubes in a vapor phase;

said carbon nanotubes which are extended in the
10 direction along a surface of said substrate from said catalyst containing film;

a first electrode which is connected to a part of said catalyst containing film side of said carbon nanotubes;

a second electrode which is connected to a part of
15 another side of said carbon nanotubes; and

a gate electrode which applies a voltage to said carbon nanotubes between said first electrode and said second electrode.

20 10. The transistor according to claim 9, wherein said carbon nanotubes includes single-wall carbon nanotubes.

11. The transistor according to claim 9, wherein said gate electrode is placed on an upper portion of the carbon
25 nanotubes.

12. The transistor according to claim 9, wherein said

gate electrode is placed on a rear surface of said substrate.

13. The transistor according to claim 9, wherein said
5 second electrode is formed so as to be separated from said first electrode and surround a periphery of said first electrode.

14. The transistor according to claim 9, wherein said
10 catalyst containing film includes:

a first region which is formed on a substrate; and
a second region which is formed covering a part of
said first region;

wherein said first region includes a catalyst
15 supporting portion containing a first material,

said second region includes a catalyst portion
containing a second material which is different from said
first material,

said first material includes a metal containing at
20 least one of elements selected from the second group to the fourteenth group of the periodic table or a compound thereof, and

said second material is a catalyst which grows carbon
nanotubes in a vapor phase.

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15. The transistor according to claim 14, wherein said
second material includes a metal containing at least one

of elements selected from a group consisting of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, La, Y, Mo and Mn or a compound thereof.

5 16. The transistor according to claim 15, wherein said first material includes a metal containing at least one of elements selected from a group consisting of Al, Mo, Ti, Ta, Cr, Cu, Mn, Mg, Zr, Hf, W, Ru, Rh, Zn and Sn or a compound thereof.

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17. The transistor according to claim 14, wherein said first region includes a metal film which contains said first material and is formed on said substrate, and
said catalyst supporting portion includes a film that
15 an upper portion of said metal film is oxidized or hydroxylated.

18. The transistor according to claim 17, wherein said second material includes a metal containing at least one
20 of elements selected from a group consisting of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, La, Y, Mo and Mn or a compound thereof.

19. The transistor according to claim 18, wherein said
25 first material includes a metal containing at least one of elements selected from a group consisting of Al, Mo, Ti, Ta, Cr, Cu, Mn, Mg, Zr, Hf, W, Ru, Rh, Zn and Sn or

a compound thereof.

20. A method for growing carbon nanotubes comprising:

(a) providing a catalyst supporting substrate,
5 wherein said catalyst supporting substrate including:
a first region which is formed on a substrate; and
a second region which is formed covering a part of
said first region;

wherein said first region includes a catalyst
10 supporting portion containing a first material,

said second region includes a catalyst portion
containing a second material which is different from said
first material,

said first material includes a metal containing at
15 least one of elements selected from the second group to
the fourteenth group of the periodic table or a compound
thereof, and

said second material is a catalyst which grows carbon
nanotubes in a vapor phase; and

20 (b) growing said carbon nanotubes by supplying raw
material gas containing carbon to a catalyst supporting
substrate.

21. The method for growing carbon nanotubes according to
25 claim 20, wherein said carbon nanotubes include
single-wall carbon nanotubes.

22. The method for growing carbon nanotubes according to claim 20, wherein said step (b) includes:

(b1) growing said carbon nanotubes in the direction along a surface of said catalyst supporting substrate.

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23. The method for growing carbon nanotubes according to claim 22, wherein said step (b1) includes:

(b11) applying an electric field with the predetermined direction to said catalyst supporting
10 substrate.

24. The method for growing carbon nanotubes according to claim 20, wherein said step (b) includes:

(b2) bringing reducing gas into contact with a
15 surface of said catalyst supporting substrate.

25. The method for growing carbon nanotubes according to claim 20, wherein said step (a) includes:

(a1) forming said first region and said second region
20 which are patterned with predetermined shapes on said substrate.

26. The method for growing carbon nanotubes according to claim 25, wherein said carbon nanotubes include
25 single-wall carbon nanotubes.

27. The method for growing carbon nanotubes according to

claim 25, wherein said second material includes a metal containing at least one of elements selected from a group consisting of Fe, Ni, Co, Ru, Rh, Pd, Os, Ir, Pt, La, Y, Mo and Mn or a compound thereof.

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28. The method for growing carbon nanotubes according to claim 27, wherein said first material includes a metal containing at least one of elements selected from a group consisting of Al, Mo, Ti, Ta, Cr, Cu, Mn, Mg, Zr, Hf, W,
10 Ru, Rh, Zn and Sn or a compound thereof.

29. The method for growing carbon nanotubes according to claim 25, wherein said step (a1) includes:

(a11) forming a catalyst supporting portion which are
15 patterned with predetermined shape on said substrate, and

(a12) forming a catalyst portion which covers a part of a surface of said catalyst supporting portion.

30. The method for growing carbon nanotubes according to
20 claim 29, wherein said step (a11) includes:

(a111) forming a metal film which contains at least one of elements selected from the second group to the fourteenth group of the periodic table, and

(a112) forming said catalyst supporting portion by
25 oxidizing or hydroxylating an upper portion of said metal film.

31. The method for growing carbon nanotubes according to claim 29, wherein said step (a12) includes:

(a121) forming said catalyst portion by any one of methods of a deposition method, a sputtering method and
5 a CVD method.

32. The method for growing carbon nanotubes according to claim 25, wherein said step (b) includes:

(b3) growing said carbon nanotubes in the direction
10 along a surface of said catalyst supporting substrate by applying an electric field with the predetermined direction to said catalyst supporting substrate.

33. The method for growing carbon nanotubes according to
15 claim 25, wherein said step (b) includes:

(b4) bringing reducing gas into contact with a surface of said catalyst supporting substrate.

34. A method for manufacturing a transistor comprising:
20 (c) forming a catalyst containing film, which is patterned with a predetermined shape, on a semiconductor substrate, wherein said catalyst containing film includes:

a first region which is formed on a substrate; and
25 a second region which is formed covering a part of said first region;

wherein said first region includes a catalyst

supporting portion containing a first material,

said second region includes a catalyst portion containing a second material which is different from said first material,

5 said first material includes a metal containing at least one of elements selected from the second group to the fourteenth group of the periodic table or a compound thereof, and

said second material is a catalyst which grows carbon
10 nanotubes in a vapor phase;

(d) growing said carbon nanotubes in the direction along a surface of said semiconductor substrate by supplying raw material gas containing carbon to said catalyst containing substrate;

15 (e) forming a first electrode which is connected to a part of said catalyst containing film side of said carbon nanotubes and a second electrode which is connected to a part of another side of said carbon nanotubes; and

(f) forming a gate electrode which applies a voltage
20 to said carbon nanotubes between said first electrode and said second electrode.